Compton Scattering

- X-rays are scattered by electrons in a crystal.
- In the particle picture for electrons and photons, this is just like an elastic collision of pool balls (chapter 9.5).
- Momentum of the photon: $p = \frac{E}{c} = \frac{hf}{c} = \frac{h}{l}$
- Momentum of the electron: $p = mv$
- Energy of the photon: $E = hf = \frac{hc}{l}$
- Energy of the electron: $E = \frac{1}{2}mv^2$

Compton Scattering

- Energy conservation: $\frac{hc}{l_0} + 0 = \frac{hc}{l'} + \frac{1}{2}mv^2$
- Momentum conservation:
  - vertical direction: $0 = mv\sin j - \frac{h}{l'}\sin q$
  - horizontal direction: $\frac{h}{l_0} = \frac{h}{l'}\cos q + mv\cos j$
- After some lengthy calculations, we get the **Compton shift equation**:

$$l' - l_0 = \frac{h}{mc}(1 - \cos q)$$

- $l_e = h/mc = 0.00243$ nm is called the **Compton wavelength** of the electron.